FORM PTO-1390 (REV 10-94) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

DOCKET #: 4925-104PUS

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
09/786331

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FI99/00724	07 September 1999	08 September 1998

TITLE OF INVENTION
A Method and a System for Detecting Communication Relaying Network Elements

APPLICANT(S) FOR DO/EO/US
Jukka SUONVIERI

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. [x] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [x] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [x] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [x] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] has been transmitted by the International Bureau.
   c. [] is not required, as the application was filed in the United States Receiving Office (RO/US)
6. [] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [x] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] have been transmitted by the International Bureau.
   c. [x] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [] have not been made and will not be made.
8. [] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [x] An **unexecuted** oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. Below concern other documents or information included:

11. [x] An Information Disclosure Statement under 37 CFR 1.97 and 1.98 and four (4) cited prior art references.
12. [] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [x] A **FIRST** preliminary amendment.
    [] A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. [] A substitute specification.
15. [x] A change of address letter.
16. [] Other items or information: International PCT Application as Published, Int'l Preliminary Examination Report, Written Opinion, Reply to Written Opinion, Int'l Search Report, PCT Request, PCT Demand, Notification of the Recording of a Change, Notice Informing the Applicant of the Communication of the International Application to Designated Offices

U.S. APPLICATION NO (If known, see 37 C F R) 09/786331	INTERNATIONAL APPLICATION NO PCT/FI99/00724	ATTORNEY'S DOCKET NUMBER 4925-104PUS

17.[x]The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO ..... $860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) ..... $690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... $710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... $1000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$860.00
Surcharge of **$130.00** for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		$

Claims	Number Filed	Number Extra	Rate	
Total Claims	20 - 20 =	0	x $18.00	$
Independent Claims	3 - 3 =	0	x $80.00	$
Multiple dependent claim(s) (if applicable)			+ $270.00	$
TOTAL OF ABOVE CALCULATIONS =				$
Reduction of ½ for filing by small entity, if applicable.				$
SUBTOTAL =				$860.00
Processing fee of **$130.00** for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$
TOTAL NATIONAL FEE =				$860.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$
TOTAL FEES ENCLOSED				$860.00
Amount to be refunded:				$
charged:				$

a. [x] One check in the amount of **$860.00** to cover the above fees is enclosed.
b. [] Please charge my Deposit Account No. 03-2412 in the amount of $____ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-2412. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
Michael C. Stuart
Cohen, Pontani, Lieberman & Pavane
551 Fifth Avenue, Suite 1210
New York, New York 10176

Michael C. Stuart

Michael C. Stuart
Registration Number: 35,698
Tel: (212) 687-2770

By Express Mail # EL628565803US · March 1, 2001

Attorney Docket # 4925-104PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of

Jukka SUONVIERI *et al.*

International Appln. No.: PCT/FI99/00724

International Filing Date: September 07, 1999

For: A Method and a System for Detecting Communication Relaying Network Elements

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231
BOX PCT

S I R:

Prior to examination of the above-identified application, amend the application as follows:

IN THE CLAIMS:

Cancel claims 1 to 20, without prejudice.

Add the following new claims:

21. A method for detecting network elements relaying communications between a base station and a mobile station in a cellular communication network, said method comprising the steps of:

monitoring time delays between base stations and mobile stations; and

detecting the communication relayed via at least one of the elements by the increase of time delay compared to the time delay of mobile stations communicating directly with the base station.

22. A method according to claim 21, further comprising the step of:

identifying the communication relaying elements on the ground of communication time delays.

23. A method according to claim 21, wherein the timing advance value corresponding to the said time delay is calculated.

24. A method according to claim 23, wherein the communications with timing advance values greater than some predetermined value are determined to be relayed via at least one of the said elements.

25. A method according to claim 24, wherein the said predetermined value is zero.

26. A method according to claim 21, wherein the mobile communication network is a GSM network.

27. A method according to claim 21, further comprising the step of:

sending an event notice to a network management system, when a presence of at least one of said elements is detected for the first time.

28. A method according to claim 21, wherein the time delay is monitored by a base transceiver station (BTS).

29. A method according to claim 21, wherein the time delay is monitored by a base station controller (BSC).

30. A method according to claim 21, further comprising the step of:

monitoring the communication relayed via at least one of said elements to determine various parameters giving information about the functioning of the network and said elements.

31. A method according to claim 21, wherein at least one of said elements is a radio repeater.

32. A method according to claim 21, wherein at least one of said elements is an optical tunnelling configuration.

33. A system for detecting network elements relaying communications between a base transceiver station and a mobile station in cellular communication network, where time delays between base transceiver stations and mobile stations are monitored, the system comprising:

means for detecting communication relayed via at least one of the elements by the increase of time delay compared to the time delays of mobile stations communicating directly with the base transceiver station.

34. A system according to claim 33, the system further comprising means for identifying communication relaying elements on the grounds of the communication time delays.

35. A system according to claim 33, wherein the mobile communication network is a GSM network.

36. A system according to claim 33, the system further comprising means for sending an event notice to a network management system when a presence of at least one of said elements is detected for the first time.

37. A system according to claim 33, the system further comprising means for carrying out measurements from the communication relayed via at least one of said elements.

38. A network element for cellular communication networks comprising:

a system for identifying communication relaying elements on the grounds of the communication time delays.

39. A network element according to claim 38, wherein the network element is a base transceiver station (BTS).

40. A network element according to claim 38, wherein the network element is a base station controller (BSC).

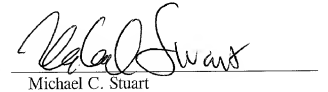
REMARKS

It should be noted that during PCT prosecution, page 2 was amended and a new page 2 was substituted, page 2b was added, and page 9 was amended and a new page 9 was substituted, and that this application contains these three substituted and/or new pages.

This preliminary amendment is presented to place the application in proper form for examination. No new matter has been added. Early examination and favorable consideration of the above-identified application is earnestly solicited.

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully Submitted,
COHEN, PONTANI, LIEBERMAN & PAVANE

By: 

Michael C. Stuart
Reg. No. 35,698
551 Fifth Avenue, Suite 1210
New York, N.Y. 10176
(212) 687-2770

1 March 2001

A method and a system for detecting communication relaying network elements

The present invention refers to a method for detecting communication relaying network elements in cellular communication networks as stated in the preamble of the appended independent claim 1. The present invention also refers to a system for detecting communication relaying network elements in cellular communication networks as stated in the preamble of the appended independent claim 13. Further the present invention also refers to a network element for cellular communication network as stated in the preamble of the appended independent claim 18.

To offer better services to their customers the operators of cellular communication networks are placing increasing numbers of base stations or Base Transceiver Stations (BTS) inside buildings, so that customers using their mobile phones and other mobile communication equipment have acceptable quality of service also indoors. It is quite typical to configure these indoor base stations so that a cell covering only one floor or even a single room of a building is formed. The cells used in cellular communication networks are classified as macro-, micro- and even picocells according to the size of the coverage area of a cell. The size of indoor cells mentioned above are typically under 100 m placing them in the microcell category.

In figure 1a a floor plan 10 of a typical office building is shown. A base station 11 is placed inside the building so that a micro cell consisting three sectors 12a, 12b and 12c is formed.

As there are typically many walls and other obstacles that hinder the propagation of electromagnetic waves inside a building, dead zones, like the zone 13 shown in figure 1a, are formed. A mobile station 16 in a dead zone 13 can not establish communication with the base station 11 or even if the connection can be made, the quality of the connection is poor. To eliminate these dead zones, radio repeaters that are used as relay stations between the mobile station 16 and the base station 11, are placed in locations where they can receive the communication from the mobile station 16 in a dead zone 13 of a base station 11 and where they can relay these communications to the base station 11. Naturally communications from the base station to the mobile station can also be carried out with similar fashion.

In figure 1b a floor plan identical to the floor plan in figure 1a is shown. However, in figure 1b a radio repeater 14 is placed so that the coverage area 15 of the radio repeater 14 covers the dead zone 13 of the base station 11, shown in figure 1a.

In figure 2 it is shown how a mobile station 21b, situated behind an obstacle 22 in a dead zone of the base station 11 communicates with the base station 11 via a radio repeater 14. When a mobile station 21b is used, the radio repeater 14 receives the communication and transmits it to the base station 11, typically using the same channel, although in some cases the use of channel changing radio repeaters are preferred. Accordingly the communication from the base station 11 is relayed via the radio repeater 14 to the mobile station 21b. Communications between the base station 11 and a second mobile station 21a that is within the coverage area of the base station are performed directly without radio repeater 14.

A basic radio repeater consists of a receiving and a transmitting section with at least two antennas, one covering the dead zone of the base station and another to carry out the communication with the base station. A typical use of radio repeaters is just to relay the received communications in a same channel, both downlink from the base stations to the mobile station and uplink from the mobile station to the base station. For economical reasons there is no sophisticated monitoring equipment usually included in the radio repeaters. Therefore in the prior art there is no way of getting any information about the operation of the radio repeaters to the network management system. This can cause situations where a radio repeater can be out of operation without the operator knowing it before receiving complaints from customers who have noticed that they have a dead zone in some area.

For the man skilled in the art an obvious solution to get more information about the function of radio repeaters would be to include sophisticated monitoring equipment in a radio repeater. This equipment could then be connected directly or through the base station to the network management system. This solution would however mean a considerable increase in the manufacturing cost of the radio repeater.

The document WO 96/07250 describes various problems and arrangements regarding repeaters. However, those arrangements do not provide solutions for the present problems.

An object of the present invention is to provide a new method for detecting communication relaying network elements, like radio repeaters. The method can be utilised without any monitoring equipment in the element itself thus eliminating the above stated problems of the prior art.

A further object of the present invention is to provide a new system for detecting communication relaying network elements, like radio repeaters. The system can be utilised without any monitoring equipment in the element itself.

A further object of the present invention is to provide a new network element comprising a system for detecting communication relaying network elements, like radio repeaters. Current network elements can be converted to the network elements according the invention with software modifications making the conversion easy and economically feasible.

The above stated objects are achieved by monitoring the time delay between a mobile station and a base station to determine if the communication is relayed via at least one relay element or performed directly with the base station. The communications from a mobile station performed via at least one relay element are detected by the increase of time delay compared to the time delay of mobile stations communicating directly with the base station.

More specifically the above stated objects are achieved by the means of a method, a system and a network element which are characterised by what is stated in the characterizing portions of the appended independent claims 1, 13 and 18. Preferred embodiment of the invention are described in dependent claims.

Compared to the prior art, the present invention gives significant advantages. When the information coming via a relay element can be recognised, it is possible to get information about the operation of relay elements to the operator, for example through the network management system (NMS). This gives the operator more complete understanding about the network and assists the operator to identify possible problems caused by relay elements, thus enabling the operator to improve the quality of the service offered to the customers.

The present invention is also quite simple and economical to implement to the present cellular networks as there is no need for additional hardware, neither for base station nor to relay elements. The method according the present invention can be implemented with only software modifications to present cellular communications networks.

The present invention will now be described more in detail in the following with the reference to the accompanying drawing, in which

Figs. 1a and 1b show schematically how a dead zone of a base station can be covered with a use of a radio repeater,

Fig. 2 shows schematically the use of radio repeaters in cellular communication networks,

Figs. 3a and 3b show schematically the reception and transmission cycles of GSM-mobile station located close to and far from a base station,

Fig. 4 shows a flow chart of an embodiment of the method according the present invention,

Fig. 5 shows schematically the use of optical tunnelling in cellular communication networks,

Fig. 6 shows a distribution of communications as a function of time delay, and

Figs. 7a and 7b show network elements comprising a system according the present invention.

Figs. 1 and 2 have been discussed above in context of the prior art.

In fig 3a a structure of reception and transmission frames of a GSM mobile station located close to the base station is shown. As stated in the GSM standard the transmission frame 31b has been delayed from the reception frame 31a by three burst periods (BP) [1]. In fact, the convention is that the numbering of the uplink slots (transmission of the mobile station) is derived from that of the downlink (reception of the mobile station) ones by a shift of 3 burst periods [1]. As the transmission and reception of the mobile phone is done with the same slot number, slot 2 in fig. 3a, this allows mobile station to avoid emitting and receiving simultaneously, thereby promoting easier implementation, when the receiver in the mobile station need not be protected from the emitter of the same mobile station.

When the mobile station is far from the base station the propagation delays between a mobile station and a base station are no more negligible compared to the burst duration. As the base station may have to handle communications with several mobile stations simultaneously it is imperative that the bursts from each mobile station are received in correct time slots. Otherwise the bursts coming from different mobile stations could overlap resulting poor transmission quality. This has been solved in present networks by controlling the time delay between the reception and transmission frames of the mobile station. This is done using timing advance (TA).

In figure 3b it is shown how the timing advance is used in determining the time delay between reception and transmission cycles of mobile station. When a base station, a base station controller (BSC) or another entity for determining the timing advance has determined a proper timing advance value for example using methods explained in reference [1] pages 346-349, the timing advance value is sent to the mobile station using methods also known *per se*. When the mobile station receives a timing advance value, it advances the transmission of its transmission slot by the amount indicated by the timing advance value. Therefore, from the point of view of the mobile station the time difference between the downlink frame 31a and the uplink frame 31b is no more three times the burst period (BP), as in fig. 3a, but three times the burst period (BP) minus the timing advance (TA) indicated by the received timing advance value, as in fig 3b.

It is evident from what was explained above that the timing advance is increased, when the propagation delay between the base station and the mobile station is increased. When a mobile station is closer than 500 m to a base station in a GSM network environment the propagation delays between the base station and the mobile station are negligible, resulting in a zero timing advance. This is the case for a mobile station located in a microcell, which are by definition quite small. The situation changes when the communication is relayed via a relay element like a radio repeater in figure 2. The radio repeater causes some delay for the communications between a mobile station and a base station. The base station can observe the presence of a radio repeater from an increase of the timing advance. It is quite typical that timing advance of a mobile station communicating with the base station via a radio repeater will correspond to a timing advance caused by a distance of several kilometres. In a microcell environment where maximum actual distances where mobile station can be situated and still be able to communicate with the base station is typically only a few hundred meters. Therefore it is possible to use the timing advance value for determining if the communication between a mobile station and a base station is performed via a radio repeater or any other delay causing network elements.

In fig 4 a flow chart of an embodiment of a method according the present invention is presented. In the step 41 a base transceiver station (BTS) receives a transmission transmitted by a mobile station. This transmission is in typically a burst containing digitised information, like in GSM networks. The burst can be normal data burst, an access burst or any other kind of information that can be used to determine the timing advance of a mobile station.

In the step 42 the timing advance (TA) is determined by a base transceiver station, a base station controller (BSC), or another entity which determines the timing advance. Timing advance can be expressed in microseconds or a timing advance value with an integer value (typically 0-63 in GSM networks) corresponding to the actual timing advance.

In the step 43 it is determined if the timing advance is greater that the maximum timing advance possible for a mobile station situated in the coverage area of the base station and communicating directly with the base station. In a microcell in a GSM network this can usually be done quite simply as the timing advance values for all mobile stations communicating directly with the base station are zero, thus simplifying the step 43 only to the checking of the timing advance value already calculated in step 42. If the timing advance value is greater than zero then the communication is judged in step 44 to be coming via a delay causing relay element, like a radio repeater. In some advantageous embodiments of the invention, even the identification of the relay elements is carried out in step 44 using the method to be described in context of fig.6.

If the timing advance value is equal to zero, it is concluded in step 49 that the mobile station is communicating directly with the base station.

When it has been concluded in step 44 that the communication is performed via a relay element, this information may be used in many different ways, some of which are included in the flow chart in fig. 4. In the step 45 it is determined if it has been detected before that there is a relay element in that particular cell. If there is no earlier indications about relay elemement in the said cell then in step 46 a notice informing about the presence of a relay element in said cell is sent to the network management system to be included to the data base.

After the notice has been sent in step 46 or if the presence of a relay element was already known, directly after step 45, it is checked in step 47 if there are any particular measurements to be carried out for the communications performed via a relay element. These measurements for example updating performance management counters such as dropped call ratio and hand over failures are then carried out in step 48.

In step 50 normal information processing is carried out for the bursts received in step 41, both for the bursts coming via the relay elementas for the bursts coming

directly from the mobile station. After step 50 it is returned back to the step 41 for receiving a new burst.

The method described above is not limited only to the indoor or microcell use, but can also be used for example in macrocells if a maximum timing advance for a mobile station communicating directly with the base station can be found and a timing advance caused by a relay element is greater than this maximum timing advance. Then the limiting criteria in step 43 in fig. 4 is not limited to that the value is greater than zero, but greater than a some cell specific value.

In fig. 5 another communication relaying network element namely optical tunnelling configuration is shown. With optical tunnelling configuration a coverage area of a base station 11 can be extended to locations that cannot be readily covered with a simple radio repeater. Optical tunnelling configurations are used for example when a coverage area of a base station is extended into two separate buildings.

In optical tunnelling configuration communications between a mobile station 21b and a base station 11 is performed via two receiving/transceiver sections 54a and 54b, two electro-optical converters 52a and 52b, and via optical transfer means 51.

The first receiving/transceiver sections 54a relays communications between the base station 11 and the first electro-optical converter 52a. The first electro-optical converter 52a converts communications received by the first receiving/transceiver sections 54a to optical information and sends the optical information via optical transfers means 51 to the second electro-optical converter 52b. The second electro-optical converter 52b converts received optical information to electrical form and transfers it to the second receiving/transceiver section 54b relaying information to the mobile station 21b. Accordingly communications from the mobile station 21b is relayed via second receiving/transceiver section 54b and second electro-optical converter 52b to optical transfer means 51, where it is received by the first electro-optical converter 52a transferring the information to the first receiving/transceiver sections 54a and further to the base station 11.

Receiving/transceiver sections 54a and 54b and electro-optical converters 52a and 52b cause time delays for the communication between the mobile station 21b and the base station 11. Therefore the present invention can also be used for detection of optical tunnelling configurations.

In figure 6 an example of a distribution of communications in a cell as a function of time delay is shown. The cell has two different relaying elements.The first peak 62

in the distribution is caused by the communications performed directly with the base station. The second peak 63 is caused by the communications performed via the first relay element, for example radio repeater. The third peak 64 is caused by the communications performed via the second relay element, for example optical tunnelling configuration.

In figure 6 the maximum time delay 61a for a mobile station communicating directly with the base station is shorter than the minimum time delay caused by the relay elements. Therefore it can be concluded that communications with time delay in interval A in figure 6 are performed directly with the base station. The maximum time delays 61b and 61c for communications performed via the first and second relay elements are known and the minimum time delay for communication performed via the second relay element is longer that the maximum time delay 61b for communication performed via the first relay element. Therefore in can be concluded that communications having time delay within interval B are performed via the first relay element and those having time delay within interval C are performed via the second relay element.

If the distribution of communications as a function of delay times show a clear multipeak distribution, like in figure 6, the present invention can by used not only to identify that a communication is performed via a relay element, but also to identify the relay elements performing the communication. An analysis of possible time delay intervals for each particular cell should be carried out before making detailed identification of elements, so that the individual characteristics of each cell could be taken into account.

The present invention can also be used for detecting malfunctioning elements. This can be accomplished for example by storing an indication of the existence of a delay every time a delay causing relay element is detected in a cell. Using some monitoring means these indications can then be monitored. When enough time have been passed since a relay element was previously detected in a cell, a notice informing about a possible malfunction in a relay element in that cell can be sent to the operator.

The present invention is not limited only to the examples presented above, but can also be used to detect also any other kind of delay causing network elements. Furthermore the present invention is not limited only to the GSM network, but can be utilised in all kind of cellular communications networks, such as the UMTS network, where timing advance or similar methods are used to compensate the

propagation time delays between a base station and a mobile station. Therefore the actual way of determining the timing advance is not relevant to the present invention.

In fig 7a and 7b two embodiment of a system 70 according the present invention are shown. In figure 7a the system is placed in a Base Station Controller 72 and in 7b the system 70 is placed in a Base Transceiver Station 74. The system 70 has I/O-interface 76 via which the system can communicate with the Network Management system 75 and monitor communications between BTS 74 and mobile stations 21a and 21b. Communication time delays between BTS 74 and mobile stations 21a and 21b are monitored and different relay elements identified by the processor 71. The program 73 saved in the memory 72 is used to control processor 71 so that the relay causing network elements can be detected and possibly identified using the method according the present invention.

The name of a given functional entity, such as the base station controller, is often different in the context of different cellular telecommunication systems. For example, in the UMTS system the functional entity corresponding to a base station controller (BSC) is the radio network controller (RNC). Therefore, the particular terminology used to denote various functional entities in this specification are only examples according to the GSM system, and do not limit the invention in any way.

In view of the foregoing description it will be evident to a person skilled in the art that various modifications may be made within the scope of the invention. While a preferred embodiment of the invention has been described in detail, it should be apparent that many modifications and variations thereto are possible.

REFERENCES:

[1] Michel Mouly, Marie-Bernadette Pautet: "The GSM System for Mobile Communications", ISBN 2-9507190-0-7, Palaiseau 1992.

Claims

1. A method (40) for detecting network elements relaying communications between a base station and a mobile station in a cellular communication network, where time delays between base stations and mobile stations are monitored (42), **characterised by** that the communication relayed via at least one of the elements is detected (43) by the increase of time delay compared to the time delay of mobile stations communicating directly with the base station.

2. A method (40) according to claim 1, **characterised by** that the communication relaying elements are identified (44) on the ground of communication time delays.

3. A method (40) according to claim 1, **characterised by** that the timing advance value corresponding to the said time delay is calculated (42).

4. A method (40) according to claim 3, **characterised by** that the communications with timing advance values greater than some predetermined value are determined (43) to be relayed via at least one of the said elements.

5. A method (40) according to claim 4, **characterised by** that the said predetermined value is zero.

6. A method (40) according to claim 1, **characterised by** that the mobile communication network is a GSM network.

7. A method (40) according to claim 1, **characterised by** that when a presence of at least one of said elements is detected (45) for the first time, an event notice is sent (46) to a network management system.

8. A method (40) according to claim 1, **characterised by** that the time delay is monitored by a base transceiver station (BTS).

9. A method (40) according to claim 1, **characterised by** that the time delay is monitored by a base station controller (BSC).

10. A method (40) according to claim 1, **characterised by** that the communication relayed via at least one of said elements is monitored to determine various parameters giving information about the functioning of the network and said elements.

11. A method (40) according to claim 1, **characterised by** that at least one of said elements is a radio repeater.

12. A method (40) according to claim 1, **characterised by** that at least one of said elements is an optical tunnelling configuration.

13. A system (70) for detecting network elements (14) relaying communications between a base transceiver station (74) and a mobile station (21b) in cellular communication network, where time delays between base transceiver stations (74) and mobile stations (21a, 21b) are monitored, **characterised by** that the system (70) has means (71) for detecting communication relayed via at least one of the elements (14) by the increase of time delay compared to the time delays of mobile stations (21a) communicating directly with the base transceiver station (74).

14. A system (70) according to claim 13, **characterised by** that the system (70) has means (71) for identifying communication relaying elements on the grounds of the communication time delays.

15. A system (70) according to claim 13, **characterised by** that the mobile communication network is a GSM network.

16. A system (70) according to claim 13, **characterised by** that the system (70) has means (76) for sending an event notice to a network management system (75) when a presence of at least one of said elements (14) is detected for the first time.

17. A system (70) according to claim 13, **characterised by** that the system (70) has means (71) for carrying out measurements from the communication relayed via at least one of said elements (14).

18. A network element (72, 74) for cellular communication networks, **characterised by** that the element (72, 74) comprises a system (70) for identifying communication relaying elements on the grounds of the communication time delays.

19. A network element (72, 74) according to claim 18, **characterised by** that the network element is a base transceiver station (BTS) (74).

20. A network element (72, 74) according to claim 18, **characterised by** that the network element is a base station controller (BSC) (72).

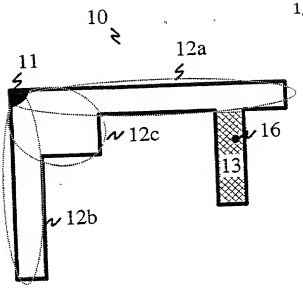


Fig. 1a

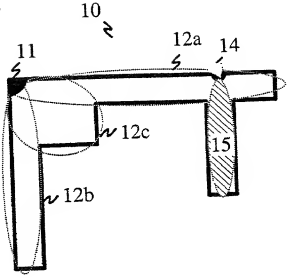


Fig. 1b

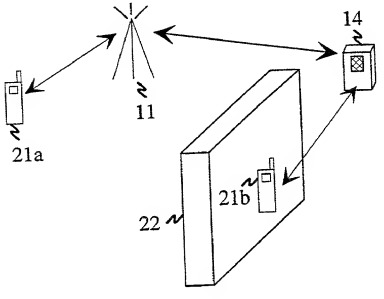


Fig. 2

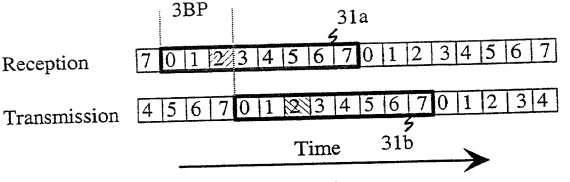

3BP
31a
Reception
7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7
Transmission
4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4
Time
31b

Fig. 3a

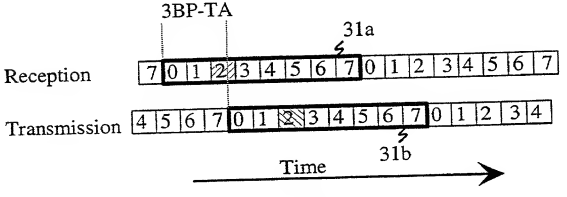

3BP-TA
31a
Reception
7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7
Transmission
4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4
Time
31b

Fig. 3b

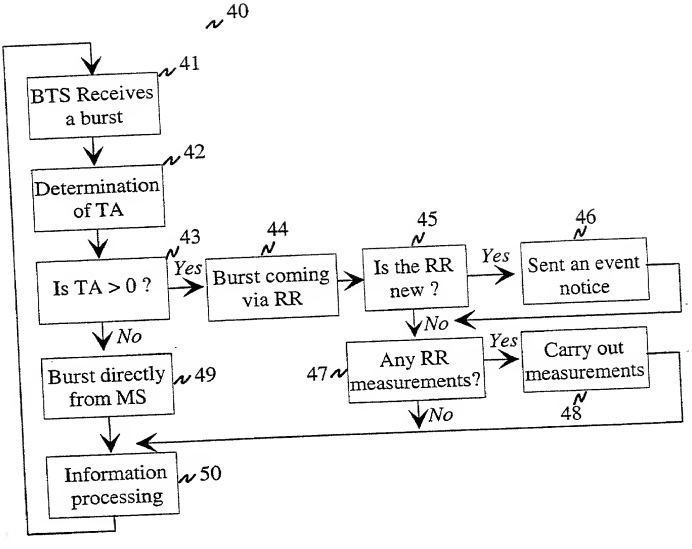

40
41
BTS Receives a burst
42
Determination of TA
43
Is TA > 0 ?
Yes
44
Burst coming via RR
45
Is the RR new ?
Yes
46
Sent an event notice
No
No
Burst directly from MS
49
47
Any RR measurements?
Yes
Carry out measurements
48
No
Information processing
50

Fig. 4

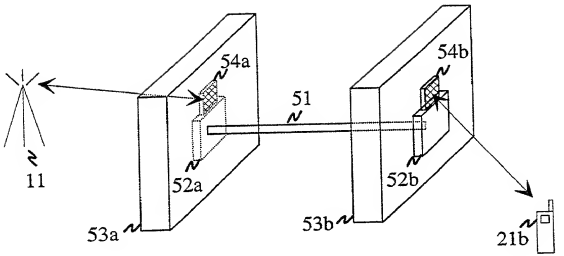

54a
54b
51
11
52a
52b
53a
53b
21b

Fig. 5

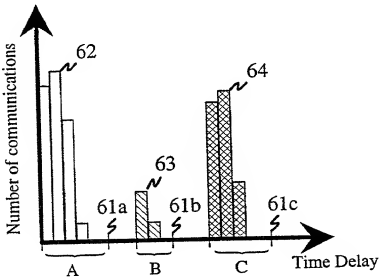

Number of communications
62
64
63
61a
61b
61c
A
B
C
Time Delay

Fig. 6

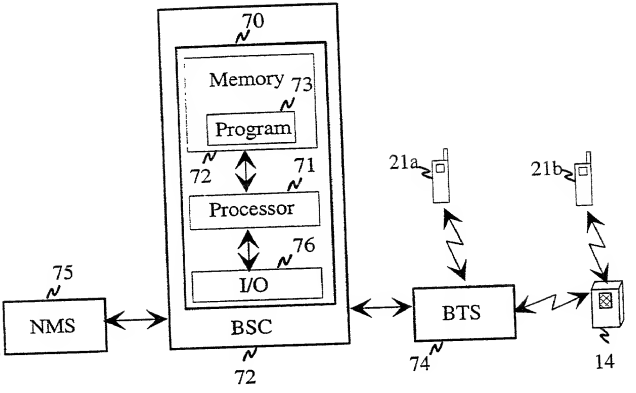

70
Memory
73
Program
72
71
Processor
76
I/O
75
NMS
BSC
72
21a
21b
BTS
74
14

Fig. 7a

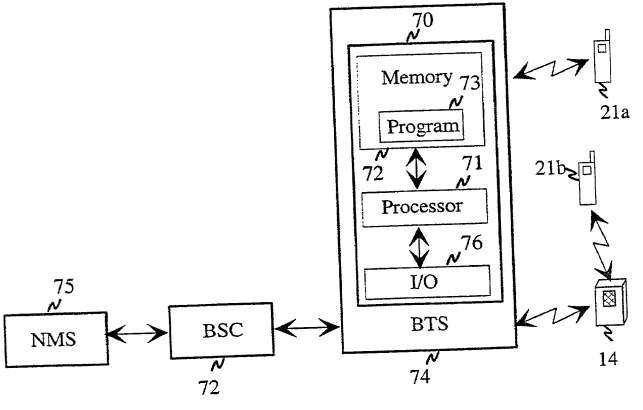

70
Memory
73
Program
72
71
Processor
76
I/O
21a
21b
75
NMS
BSC
72
BTS
74
14

Fig. 7b

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
Includes Reference to PCT International Applications

Attorney's Docket No. **4925-104PUS**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A METHOD AND A SYSTEM FOR DETECTING COMMUNICATION RELAYING NETWORK ELEMENTS

the specification of which (check only one item below)

[] is attached hereto

[] was filed as United States application

Serial No. _

on __

and was amended

on __ (if applicable).

[X] was filed as PCT international application

Number PCT/FI99/00724

On 07 September 1999

And was amended under PCT Article 19

On __ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

PRIOR FOREIGN/PCT APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
Finland	981920	08 September 1998	[X] YES	[] NO
PCT	PCT/FI99/00724	07 September 1999	[X] YES	[] NO

Combined Declaration for Patent Application and Power of Attorney (Continued)
(Includes Reference to PCT International Applications)

Attorney's Docket No. **4925-104PUS**

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS *(check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED *(if any)*			
PCT/FI99/00724	07 September 1999			√	

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (*List name and registration number*)

MYRON COHEN, Reg. No. 17,358; THOMAS C. PONTANI, Reg. No. 29,763; LANCE J. LIEBERMAN, Reg. No. 28,437; MARTIN B. PAVANE, Reg. No. 28,337; MICHAEL C. STUART, Reg. No. 35,698; KLAUS P. STOFFEL, Reg. No. 31,668; EDWARD M. WEISZ, Reg. No. 37,257; JULIA S. KIM, Reg. No. 36,567; VINCENT M. FAZZARI, Reg. No. 26,879; ALFRED W. FROEBRICH, Reg. No. 38,887; KENT H. CHENG, Reg. No. 33,849; GEORGE WANG, Reg. No. 41,419; GERALD J. CECHONY, Reg. No. 31,335; ROGER S. THOMPSON, Reg. No. 29,594; GEORGE J. BRANDT, JR., Reg. No. 22,021; F. BRICE FALLER, Reg. No. 29,532 and YUNLING REN, Reg. No. 47,019.

Send correspondence to:
Michael C. Stuart
Reg. No. 35,698
Cohen, Pontani, Lieberman & Pavane
551 Fifth Avenue, Suite 1210
New York, New York 10176

Direct Telephone calls to:
(name and telephone number)
Michael C. Stuart
(212) 687-2770

2 0 1	FULL NAME OF INVENTOR 1 - 00	FAMILY NAME SUONVIERI	FIRST GIVEN NAME Jukka	SECOND GIVEN NAME
	RESIDENCE, CITIZENSHIP	CITY FIN-33610 Tampere FIX	STATE OR FOREIGN COUNTRY Finland	COUNTRY OF CITIZENSHIP Finland
	POST OFFICE ADDRESS	POST OFFICE ADDRESS Jenseninkatu 27 B 6	CITY FIN-33610 Tampere	STATE & ZIP CODE/COUNTRY Finland
2 0 2	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE, CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)				Attorney's Docket No. 4925-104PUS
203	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE, CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 03-21-2001	DATE	DATE